MORPHOLOGICAL TOOL TO ELUCIDATE TWO CLOSELY RELATED PANGASIUS CATFISH

MUHAMAMAD YUSOF FITRI, PhD (CORRESPONDING AUTHOR)

INSTITUE OF OCEANOGRAPHY AND MARRITIME STUDIES (INOCEM), KULLIYYAH OF SCIENCE, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, MALAYSIA.
DEPARTMENT OF MARINE SCIENCE, KULLIYYAH OF SCIENCE, KULLIYYAH OF SCIENCE, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, MALAYSIA.
fitriyusof@iium.edu.my

ANNIE CHRISTANUS, PhD

DEPARTMENT OF AQUACULTURE,
FACULTY OF AGRICULTURE, UNIVERSITI PUTRA MALAYSIA,
annie@upm.edu.my

ABSTRACT

Analyses of conventional morphometric, meristic and truss morphometric were performed on two species of Pangasiid catfish, *Pangasius pangasius* and *P. nasutus*. The purpose is to find characters that help in differentiating these two species to avoid confusion among fish farmers. Three morphometric approaches (conventional, meristic and truss morphometric) were employed to identify the morphological differences. Conventional morphometric suggested eye diameter, body width, body depth, dorsal fin base length and barbells as characters that have significant differences ($P< 0.05$) between the species, hence making them as potential diagnostic markers. Truss morphometric analyses approved that *P. nasutus* have larger dorsal fin base length as suggested by conventional morphometry data. Meristic analysis showed significant difference ($P<0.05$) in number of dorsal fin rays, pelvic fin rays, anal fin rays and caudal fin rays. All three types of morphometric prove to support in elucidating the two species.

Keywords: Pangasius catfish, morphometric, morphological tool, Patin.

INTRODUCTION

Striped catfish (*Pangasianodon hypopthalmus*) is locally known as Patin Hitam in Malaysia. This species is originally from Mekong delta and introduced to Malaysia for aquaculture purposes. They gain good price and can be produced in mass by artificial breeding in hatchery. Fruit catfish (*P. nasutus*) locally recognised as Patin buah served as delicacy with price that can hike up to RM 150 per kg, in comparison to Patin Hitam that ranges from RM10 to RM20 per kg. This species is only found in Malaysia, South Thailand, Sumatera and Kalimantan.

Normally, wild adult *P. nasutus* are caught from the wild at juvenile or adult stage and placed together with *P. hypopthalmus* in floating cages before being sold.. Seed supply of *P. nasutus* are scarce in the wild, while artificial seed can only be obtained from Thailand with limited numbers. Attempt of hybridisation between *P. hypopthalmus* and *P. nasutus,* locally known as Patin Mas has been made to overcome the problem.

Difficulty to differentiate between these two species has led to confusion and argument between fish farmers and restaurants owners because *P. nasutus* has a high price in restaurants compared to *P. hypopthalmus*. Thus, it is important for fish farmers and consumers to be able to identify thme .

Morphological examination has been used in species identification, sexual dimorphism, population stock delineation and stock management program (Daud *et al*., 2005; Turan *et al.*, 2006; Champasri *et al*., 2007; Abaunza, 2008; Gunawickrama, 2008; Simon *et al*., 2010). The colours of the scale, weight and length are the examples of morphological characteristics observed in fish. Morphological data are continuous, and must be corrected to remove the size effect among specimens in contrast to meristic characters, which are discrete data (Rahim *et al*., 2009). Variations observed in morphometric characters are due to the simultaneous control of genetic and environmental factors.

However, morphometric measurements have recently been criticised because they are concentrated along the body axis with only sampling from depth and breadth, and mostly concentrated on the head (Turan, 1999). Truss morphometric is developed to overcome the disadvantages criticized upon conventional morphometric characters (Strauss and Bookstein, 1982). Truss network analysis has proven to show higher resolving power in discriminating population (Ruiz-Campos *et al*., 2009). Therefore, it is often used together with conventional morphometric and meristic data to investigate the morphological variation (Cakmak and Alp, 2010; Hossain *et al*., 2010).

In this study, the objective is to evaluate the body shape differencse between these two species using conventional morphometric characters, truss morphometric characters and meristic characters. This will help fish farmers and researchers in identifying the species on site using morphological characteristics swiftly before further analysis at the laboratory.

MATERIALS & METHODS

A total of 60 wild samples of the *P. hypopthalmus* and *P. nasutus* weighing from 400g to 2500g were collected from two locations; Kuala Kangsar and Raub (Fig. 1). The samples were keep under -20 °C to maintain their freshness. Measurements and meristic counting were taken after thawing process. The specimens were placed in position on measuring board with the head positioned on the left and the tail on the right side to take the measurements starting from the left part of the body. Total lengthwas measured first using ruler and followed by measuring other variables using hand-held electronic digital vernier callipers.

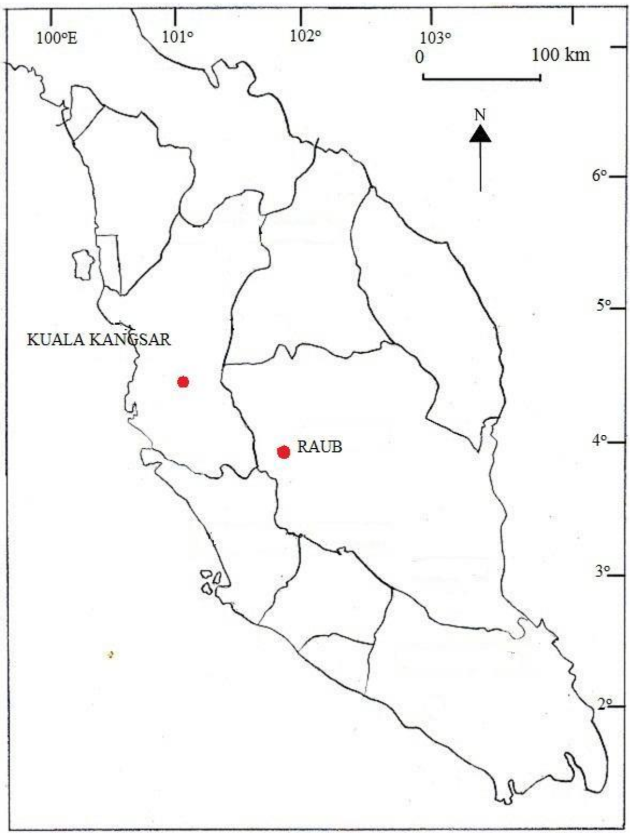

Figure 1 Sampling location of both Pangasiid catfish species

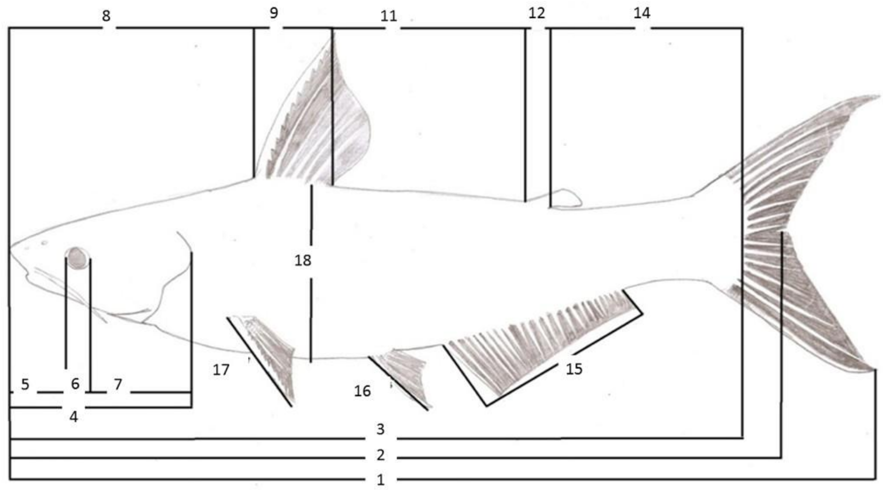

Figure 2 Lateral view of Pangasiid catfishes for conventional morphometric measurement.

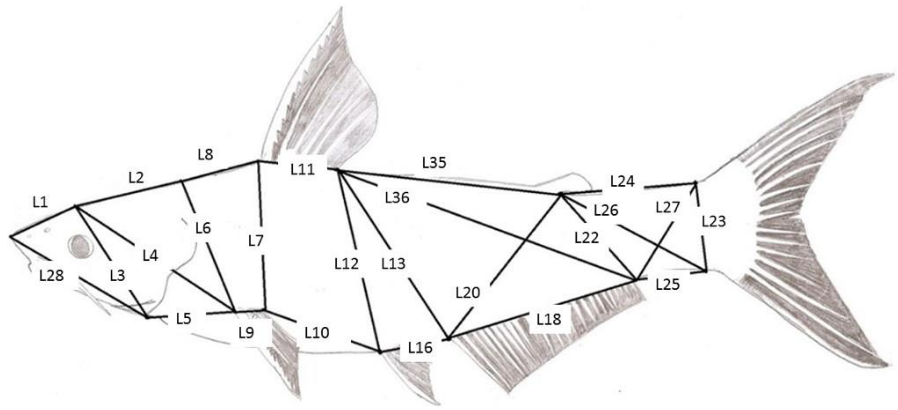

Figure 3 Lateral view of Pangasiid catfishes truss morphometric measurement.

Morphometric characteristics measurement included the: total length (TL), fork length (FL), head length (HL), standard length (SL), preorbital eye length (PrOEL), eye diameter (ED), postorbital eye length (PsOEL), head width (HW), body width (BW), premaxilla to anterior end of dorsal fin (PAD), dorsal fin base length (DFBL), distance from posterior end of dorsal to anterior end of adipose fin (DDA), adipose fin base length (AdFBL), distance from posterior end of adipose fin to posterior end of caudal fin (PAdPC), anal fin base length (AFBL), pelvic fin length (PvL), pectoral fin length (PcL), body depth (BD), nasal barbells, maxillary barbells, inner mandibular and outer mandibulary barbells (Fig. 2). All measurements were measured to two decimal points.

Truss morphometric characters for body consisted of 34 characters (Fig. 3). Characters L1-L6 and L28 explained the head shape and L7-L27 were on the body shape and caudal shape in catfish. For truss characters on the head, measurements were taken from dorsal view. Some characters were explained by Cabuy *et al*. (1999) whereas H1 and H2 were representing the snout length, H3 and H4 represented the posterior part of head, while H6-H10 represented the head width and distance between the two points accordingly. H8 was removed from Pangasiid catfish because the eye position did not favour the measurement. H11-H16 characters represented the head width and length from various mid points.

Five meristic characters were counted; number of spine and rays for dorsal fin, pectoral fin, pelvic fin, anal fin and caudal fin. Each character was counted three times independently. Characters that did not show similarity for three counts were recounted.

T-test analyses were performed to observe characteristics that showed significant differences between the two species. To test whether meristic characters were significantly different among species, the non-parametric Kruskal-Wallis test was used. Statistical analyses were performed using SPSS Version 17.

RESULTS

Eleven morphological characters showed significant differences (P<0.05) between the two catfish species. *Pangasius nasutus* have a larger body width and longer inner mandibular barbell compared to *P. hypopthalmus*. In contrary, *P. hypopthalmus* have longer pre anterior dorsal, eye diameter, anal fin-base length and pectoral length. *P. hypopthalmus* also have higher body depth and longer outer mandibular barbells (Table 1).

Table 1 Double tail t-test for conventional morphometric characters in Pangasiid catfish.

Characters	*P. hypopthalmus*	*P. nasutus*
PrOEL	26.18 ± 6.04^{a}	27.62 ± 2.91^{a}
ED	15.87 ± 1.72^{a}	13.71 ± 2.47^{b}
PsOEL	59.1 ± 4.10^{a}	27.62 ± 2.91^{b}
HW	61 ± 4.09^{a}	59.85 ± 8.96^{a}
TL	83.58 ± 1.92^{a}	83.89 ± 3.1^{a}
HL	20.68 ± 1.53^{a}	20.24 ± 2.05^{a}
BW	10.53 ± 0.61^{a}	12.99 ± 1.46^{b}
PAD	36.18 ± 2.89^{a}	35.1 ± 1.89^{b}
DFBL	6.03 ± 0.87^{a}	7.99 ± 0.91^{b}
AFBL	26.34 ± 1.22^{a}	22.14 ± 1.28^{b}
PVL	12.81 ± 0.84^{a}	11.23 ± 0.86^{b}
PCL	17.09 ± 1.05^{a}	15.63 ± 1.27^{b}
BD	20.31 ± 0.84^{a}	19.94 ± 2.02^{b}
INNER MANDIBULAR	4.64 ± 1.84^{a}	5.54 ± 1.14^{b}
OUTER MANDIBULAR	10.27 ± 3.23^{a}	8.32 ± 1.67^{b}

Different uppercase alphabets in superscript in each row show significant differences ($p<0.05$)

Double tail t-test was performed using data of truss morphometry showing that 24 out of 44 measurements were significantly different (P < 0.05) between two species (Table 2). L1-L4, L28, H2-H6,H10 and H11 were characters measured from the head region, L9-L11 were characters measured for fin base region and L22-L27 were characters measured for caudal peduncle region. These characters showed significant differences (P < 0.05) between two *Pangasius* catfish species studied.

Table 2 Double tail t-test for truss characters in Pangasiid catfish.

Characters	*P. hypopthalmus*	*P. nasutus*
L1	37.9 ± 3.73[a]	33.69 ± 4.85[b]
L2	54.73 ± 7.93[a]	62.1 ± 7.7 [b]
L3	44.75 ± 4.73[a]	60.88 ± 8.96[b]
L4	57.55 ± 6.88[a]	71.93 ± 11.43[b]
L9	21.31 ± 4.04[a]	25.44 ± 4.15[b]
L10	73.94 ± 10.69[a]	96.11 ± 17.45[b]
L11	30.76 ± 4.31[a]	40.91 ± 7.66[b]
L16	52.90 ± 8.64[a]	61.90 ± 10.94[b]
L18	125.67 ± 15.93[a]	111.02 ± 16.71[b]
L20	123.84 ± 14.69[a]	106.34 ± 15.21[b]
L22	53.83 ± 6.88[a]	42.35 ± 7.12[b]
L23	35.73 ± 4.26[a]	47.65 ± 8.22[b]
L24	49.38 ± 7.44[a]	81.30 ± 8.47[b]
L25	19.30 ± 3.65[a]	44.76 ± 7.68[b]
L26	67.54 ± 8.40[a]	79.15 ± 13.37[b]
L27	39.61 ± 4.93[a]	65.12 ± 9.94[b]
L28	56.42 ± 6.40[a]	74.86 ± 11.74[b]
H2	23.96 ± 2.95[a]	29.07 ± 3.25[b]
H3	46.75 ± 6.69[a]	33.17 ± 5.21[b]
H4	21.82 ± 3.48[a]	27.97 ± 4.41[b]
H5	47.82 ± 5.25[a]	77.35 ± 8.5[b]
H6	65.06 ± 7.28[a]	71.00 ± 8.74[b]
H11	60.43 ± 6.68[a]	77.36 ± 9.41[b]
H12	60.31 ± 6.69[a]	77.82 ± 9.73[b]

Different uppercase alphabets in superscript in each row show significant differences (p<0.05)

Kruskal-Wallis based on median of meristic characters in Pangasiid catfishes showed four meristic characters; dorsal fin rays, pelvic fin rays, anal fin rays and caudal fin rays were found to be significantly different (Kruskal Wallis test, p < 0.05) among the two Pangasiid species (Table 3) except for the number of pectoral fin rays.

Table 3 Summary of meristics characteristics for two species of Pangasiid catfish.

	P. hypopthalmus		*P. nasutus*	
	Median	Range	Median	Range
Dorsal Fin Rays*	7.5	7 to 9	7	6 to 8
Pectoral Fin Rays	10	8 to 12	10	8 to 11
Pelvic Fin Rays*	8	7 to 8	6	6
Anal Fin Rays*	30	25 to 33	25	21 to 27
Caudal Fin Rays*	14	12 to 17	18	16 to 20

Significantly different at p<0.05

DISCUSSIONS

Previously, *P.* hypopthalmus was misidentified as *P. pangasius* (Fishbase, 2019; Mohsin & Ambak, 1983; Pal, 2010; Roberts & Vidthayanon, 1991). Thus, in this study *P. hypopthalmus* was compared with the specimen of *P. pangasius* from Mohsin and Ambak (1983). The samples of *P. hypopthalmus* in thisstudy, is similar with the description by Mohsin and Ambak (1983) but presented with smaller maxillary barbells. Basically, *P. nasutus* has significantly (P<0.05) wider body compared to *P. hypopthalmus* but smaller in body depth and pre-anterior dorsal length. Pectoral fin length, pelvic fin length and anal fin base-length is longer in *P. hypopthalmus* compared to *P. nasutus*. The nasal barbellis longer in *P. nasutus* while maxillary barbell is significantly longer in *P. hypopthalmus* (P< 0.05).

Numerous authors have described *P. nasutus* to have strong pointed snout with very small eyes relative to the head length and the tooth band of upper jaws is entirely exposed when the jawsare closed (Kottelat *et al*., 1993; Roberts and Vidthayanon, 1991). However, the result in this study does not support the characters of snout length but supported with smaller eyes in *P. nasutus* when compared to *P. hypopthalmus.* In *P. nasutus*, the eye position is entirely above the level of the mouth, similar to the description of the species by Smith (1945).

In truss morphometric, *P. hypopthalmus* showed wider mouth but smaller in anterior head width compared to *P. nasutus*. This was explained by significantly higher (P < 0.05) value of truss character L2-L4 in *P. nasutus*. In addition for head width comparison, truss characters H4-H6 also suggesting *P. nasutus* to possess broader head than *P. hypopthalmus.* The results in truss contradict the head width result from conventional morphometric data. Truss morphometric allows measurement to be statistically removed from the analysis. Thus, in this case, correcting the results obtained from conventional morphometry characters and suggested that *P. nasutus* to have broader head than *P. hypopthalmus*. L9-L11 are also significantly higher (P < 0.05) in *P. nasutus* compared to *P. hypopthalmus* which further approved that *P. nasutus* has larger dorsal fin base length as suggested by conventional morphometry data. Morphological differences and similarities may reflect the history of their phylogenetic relationship and effect environment onto morphological characters. Morphological analysis has identified several characters to differentiate between these two species. Some of the characters are eye diameter, body width, body depth and barbells. These characteristics are easy to identify and can be measured at fish farm, which makes them potentially usable as diagnostic markers. Truss characters, aiding in further approvement of the conventional characters. In addition, meristic characters and truss characters can also assist in identifying the two species.

According to Mohsin and Ambak (1983), members of Family Pangasiidae normally have 5 to6 pelvic fin rays, and this is slightly differ from the observation by Roberts and Vidthayanon (1991) which stated 8 rays. However, the present study showed *P.nasutus* has fixed 6 pelvic fin rays while *P. pangasius* has a number of pelvic fin rays ranging from 7 to 8. Samples of *P. hypopthalmus* from Bangladesh and Kelantan showed a fixed number of six pelvic fin rays (Hossain et al, 2009; Mohsin and Ambak,1983) while *P. nasutus* from Pahang have fixed number of 5 pelvic fin rays.

Previous studies have proven that *P. nasutus* has lower number of fin rays in comparison to *P. pangasius* (Kottelat et al, 1993). Meanwhile, our study showed that number of anal fin rays in *P. nasutus* was significantly (P<0.05) lower than in *P. hypopthalmus*, which further confirmed the previous statement.

Our study also demonstrated that *P. nasutus* has a number of anal fin rays ranging from 21 to 27. The number of anal fin rays for *P. nasutus* from Pahang stated by Mohd Zafri (2006, Master thesis) was 22-24, while Roberts and Vidthayanon (1991) counted 27-30 for *P. nasutus* from Mekong.

Whilst, the number of anal fin rays in *P. hypopthalmus* in this study ranged from 25 to 33, which was slightly different from a previous study by Mohsin and Ambak (1983). Based on sample size and sampling location from the past and present studies, the differences within these species are attributed by the environmental conditions and larger specimen examined. The result from meristic analysis have confirmed two major points; firstly both species matched the description of the species by previous authors with slight differences; secondly the slight differences within the species are due to environmental factors and different sample size measured.

CONCLUSION

Hybridisation between introduced species and local species have caused confusion among fish farmers. This has raised the importance of knowing the morphometric characters that can help in identifying the two species. Three morphometric approaches have proven to rapidly assist in identifying the two Pangasiid catfish species. However, further study at molecular level is needed to verify and support the evidence.

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